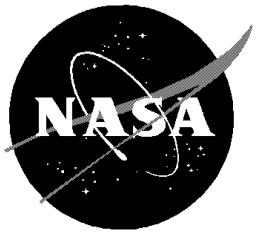
NSTS 21187
Revision D

Cell Culture Module Configuration A

Payload Integration Plan

May 1996



National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

DESCRIPTION OF CHANGES TO

PAYLOAD INTEGRATION PLAN

SPACE SHUTTLE PROGRAM

AND

CELL CULTURE MODULE CONFIGURATION A

CHANGE NO.	DESCRIPTION/AUTHORITY	DATE	PAGES AFFECTED
--	Basic issue/P21187-001	05/02/91	All
REV A	Pagination revision to include updates to table of contents, sections 3.1, 3.2.1, 3.2.2, 3.2.3, 4.1, 4.2.1.1, 5.2, 5.4, 7.1, 7.2, 9.1, 9.3, 9.4, 9.4.1, 10.1, 10.4, 13.0, table 5-1, and figure 13-1/ P21187-002	09/13/91	All
1	Update table of contents, sections 9.1 and 13.0, and figure 13-1; add section 8.6/P21187-003	02/14/92	vi,18,18A,19, 27,27A,31,32
2	Update sections 3.1, 3.2.1, 4.1, 4.2.1.1, 5.2, 5.4, 7.1, 7.2,9.3, and 13.0, figures 3-1 and 13-1, and table 5-1a; delete tables 5-1b and c/ P21187-004	10/07/92	5,6,7,8,9,11, 12,13,16,20, 27,32
	Errata to correct section 4.1	10/29/92	8
3	Update section 4.1/P21187-005A	02/16/93	8

DESCRIPTION OF CHANGES (CONCLUDED)

CELL CULTURE MODULE CONFIGURATION A

CHANGE NO.	DESCRIPTION/AUTHORITY	DATE	PAGES AFFECTED
REV B	General revision/P21187-006	11/18/93	All
1	Update table of contents, sections 2.1.1, 4.1, 5.2, 5.6, 7.1, 7.2, 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 13.0 and 16.0, and fig 13-1/P21187-007;-008	01/31/94	vii,2,10,13, 15,18,25,26, 27,28,30,33, 34,35
2	Update sections 4.2.2, 8.6, 9.1, 9.4.1, 13.0, and figure 13-1/P21187-009;-010	03/17/94	12,21,22,23, 24,30,31,34, 35
3	Update table of contents, add new section 4.2.3 and renumber remaining section/P21187-011	08/08/94	v,12,12A
4	Update sections 9.4.1 and 13.0, and figure 13-1/P21187-012	10/24/94	24,31,35
5	Update sections 4.2.2 and 4.2.2.3/P21187-013	12/05/94	11,12
6	Update sections 4.2.2.3, 7.1, 12.0, and 13.0 and figure 13-1/P21187-014	02/03/95	12,18,29,30, 35
REV C	General revision/P21187-0015	11/17/95	All
REV D	General revision/P21187-0016	05/30/96	All
1	Update section 12.0/P21187-0017	09/13/96	26
2	Update section 9.4.1/P21187-0018	11/15/96	22

Note: Dates reflect latest signature date of CR's received by PILS.

NSTS 21187

PAYLOAD INTEGRATION PLAN

SPACE SHUTTLE PROGRAM

AND

CELL CULTURE MODULE CONFIGURATION A

MAY 30, 1996

APPROVED:

Signed by Leonard S. Nicholson, dated 04/09/91
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SPACE SHUTTLE PROGRAM OFFICE

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DEPUTY FOR SPACE TRANSPORTATION SYSTEMS
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PREFACE

This Payload Integration Plan (PIP) is the United States Air Force (USAF) and National Aeronautics and Space Administration (NASA) agreement on the responsibilities and tasks which directly relate to the integration of the Cell Culture Module Configuration A (CCM-A) in the Space Shuttle. Signature of this document constitutes technical agreement on the tasks to be performed.

CONTENTS

1.0 INTRODUCTION

The National Aeronautics and Space Administration (NASA) and the United States Air Force/Space and Missile Systems Center (USAF/SMC) plan to launch and operate the Cell Culture Module Configuration A (CCM-A) using the Space Shuttle. Additional launches of the CCM-A payload are planned.

The CCM-A will fly as a nonstandard secondary payload; i.e., the payload meets the standard middeck accommodations with some minor deviations from the Standard Integration Plan (SIP) or the middeck Interface Definition Document (IDD).

For purposes of this Payload Integration Plan (PIP), the CCM-A is further categorized as a middeck payload which requires processing at NASA John F. Kennedy Space Center (KSC) for such things as buildup, battery installation, or checkout, and late installation into the Orbiter. This payload will not require NASA Lyndon B. Johnson Space Center (JSC) processing.

For purposes of this PIP, the Space Shuttle Program (SSP) shall be represented by the JSC and KSC. The CCM-A shall be represented by the USAF/SMC.

This PIP is the agreement between the NASA and the USAF/SMC that provides the management roles and responsibilities and a definition of the technical activities, interfaces, and schedule requirements to accomplish the integration, launch, on-orbit operation, and postlanding operations of the CCM-A with the SSP. All services to be furnished by the SSP to the USAF/SMC under this PIP shall be furnished by the SSP using its best efforts.

2.0 MANAGEMENT RESPONSIBILITIES

The responsibility for assuring the definition, control, implementation, and accomplishment of the activities identified in this document for the SSP is vested with the SSP at the NASA JSC and for the CCM-A with the USAF/SMC. Hereafter in this PIP, the USAF/SMC will be referred to as the customer and the CCM-A will be referred to as the payload.

2.1 Joint Responsibilities

The SSP and the customer will support the necessary integration activities, both analytical and physical, identified in this plan and according to the schedule contained in section 15.0. The SSP

and the customer will staff the interface working groups with the technical personnel responsible for the accomplishment of the integration tasks. The interface working groups include management, crew compartment, structural/mechanical/materials, avionics, thermal, flight planning, flight operations and ground operations.

2.1.1 Documentation.- The primary documentation to ensure proper integration of the payload will consist of the PIP, the PIP annexes, and appropriate Interface Control Documents (ICD's). The PIP, PIP annexes, payload-unique ICD, and associated changes will be jointly approved by the SSP and the customer. However, any technical change that may result in an increase in total charges for services provided or total costs incurred by the SSP under this PIP must be referred to the Associate Administrator for Space Flight or the associate administrator's designee for approval. Where the customer is authorized to provide or specify its requirements in a PIP annex or an ICD, these requirements are subject to SSP approval. Configuration control will be initiated upon signature approval. The NASA JSC will maintain configuration control of the cited documentation in accordance with the Mission Integration Control Board Configuration Management Procedures, NSTS 18468, with the exception of the Launch Site Support Plan (LSSP) Annex (Annex 8), which will be maintained by the KSC in accordance with Payloads Configuration Management Handbook, KHB 8040.4.

If an inconsistency occurs involving safety, Safety Policy and Requirements for Payloads Using the Space Transportation System, NSTS 1700.7B, and Space Transportation System Ground Safety Handbook, 45 SPW HB S-100/KHB 1700.7, as modified by any NASA-approved waivers, will take precedence. Unless otherwise stated within this document, all other inconsistencies shall be resolved by giving precedence in the following order:

a. Payload Integration Plan

b. Payload Interface Control Documents referenced in the Payload Integration Plan

c. Annexes to the Payload Integration Plan

d. Applicable documents of the Payload Integration Plan other than b above

2.1.2 Reviews.- The customer participates in the following reviews which will be implemented to assess the cargo integration process as described in the Space Shuttle System Payload

Accommodations, NSTS 07700, Volume XIV. Support may be data input, telecon, or designated representative, as agreed by the SSP and the customer.

a. Payload Safety Reviews (PSR's)

b. Cargo Integration Review (CIR)

c. Flight Operations Review (FOR)

d. Ground Operations Review (GOR)

e. Flight Certification Review (FCR)/Payload Readiness Review (PRR)

f. Flight Readiness Review (FRR)

g. Payload Status Review - periodically

2.1.3 Proprietary Data.- In the event any of the data which the customer is required to furnish as part of the payload integration and safety process qualifies under the law as a trade secret or commercial or financial information and is confidential or privileged, and the customer desires to continue protection of such data, the customer shall mark the data with the following notice. NASA will thereafter treat the data in accordance with the notice.

NOTICE

These data embody trade secrets or commercial or financial information and are confidential or privileged, and shall not be used or disclosed other than for payload integration, safety, and associated launch services without prior written permission of the customer.

2.2 SSP Responsibilities

The NASA JSC is responsible for integration of the payload into the Space Shuttle, including analytical integration, integrated flight design, integrated flight operations, and compatibility with other cargo elements that share the same flight. The NASA JSC is also responsible for assuring that any other SSP activities required to support the payload flight are

accomplished. The NASA JSC is responsible for specifying to the customer all SSP requirements in the appropriate timeframe.

The NASA KSC is responsible for the Space Shuttle Launch and Landing (L&L) support which includes agreed-upon facilities and services, physical integration of the payload(s) and integrated checkout, ground integration of the payload and Space Shuttle, and postlanding activities.

2.3 Customer Responsibilities

The customer is responsible for the design, development, test, performance, and safety of the payload and Ground Support Equipment (GSE), as well as for providing support to the SSP analytical and physical integration activities identified in this PIP. The customer is also responsible for the buildup and checkout of the payload and is responsible for responding in the appropriate timeframe to SSP requirements set forth in this document. The customer is responsible for identifying to the SSP all payload problems which may affect SSP milestones, as identified in section 15.0, and shall discuss with the SSP a plan to resolve the problem(s).

The customer will support the Certification of Flight Readiness (COFR) process as described in NSTS 07700, Volume XIV, Space Shuttle System Payload Accommodations. The customer will also support the Integrated Cargo Hazard Assessment (ICHA) if required.

2.4 The Authority and Responsibilities of the NASA Space Shuttle Commander

The authority and responsibilities of the NASA Space Shuttle commander are as stated in the Code of Federal Regulations, Title 14, Part 1214, Subpart 1214.7. The Space Shuttle commander has the absolute authority to take whatever action is necessary to provide for the safety and well being of all personnel and equipment onboard.

2.5 Authority and Responsibilities of the Payload Commander

For missions with extensive crew training requirements and/or complex crew interactions, a payload commander may be designated. This payload commander will be an experienced mission specialist and will be assigned at approximately Launch minus 22 (L-22)

months. Prior to the assignment of the Space Shuttle commander, the payload commander will have full authority to represent the Flight Crew Operations Directorate and the Astronaut Office on all matters specific to the assigned flight. The payload commander will be responsible for working with the payload mission managers to identify and resolve issues associated with experiment assignments, training, crewmember qualification, and operational constraints. After assignment of a Space Shuttle commander, the payload commander will continue to retain payload responsibility throughout the preflight preparation and flight. Per paragraph 2.4, ultimate onboard authority for the successful execution of the flight rests with the Space Shuttle commander.

2.6 Authority and Responsibilities of the Mission Management Team and the Cargo Management Team

2.6.1 Mission Management Team.- The authority and responsibilities of the Mission Management Team (MMT) are established in Space Shuttle Operations, NSTS 07700, Volume VIII. The MMT will function as a program-level oversight group to review the status of countdown and flight activities and to make programmatic decisions outside the authority of the launch and flight teams. When necessary to deviate from established Launch Commit Criteria (LCC) or Flight Rules (FR's) to safely conduct SSP operations or to meet mission objectives, the single approval authority for such actions is the MMT chairman or designated representative. The single representative to the MMT on matters involving the Shuttle cargo is the Flight Manager, SSP.

2.6.2 Cargo Management Team.- The customer's interface to the MMT is through membership on the Cargo Management Team (CMT). This team, which is chaired by the Flight Manager, SSP, consists of SSP and customer management representatives who have the authority and technical knowledge to make final programmatic recommendations to the MMT on issues which affect the payload. CMT membership, responsibilities, and functions are payload specific and are addressed further in Flight Operations Support Annex (FOSA), Annex 3.

3.0 PAYLOAD DESCRIPTION AND MISSION OVERVIEW

This section contains a general payload description and a mission overview. It is not intended to specify requirements or constraints that should be specified in other sections.

3.1 Payload Description

The objectives of the payload are to validate models for muscle, bone, and endothelial cell biochemical and functional loss induced by microgravity stress; to evaluate cytoskeleton, metabolism, membrane integrity and protease activity in target cells; and to test tissue loss pharmaceuticals for efficacy. The experiment unit fits into a single standard middeck locker which has a modified locker door with its panels removed. The unit takes in and vents air to the cabin via the front panel. The experiment is powered and functions continuously from prelaunch through postlanding. Before Orbiter installation and after postlanding removal, the payload will be powered by an SSP-provided GSE battery system (28 ± 4 V direct current (dc)). The experiment consists of two major subassemblies, the power/electronics module and the analysis module.

The CCM-A power/electronics module supplies power to the experiment, fusing for circuit protection, and a display for experiment and housekeeping status information. The power/electronics module also contains the control panel with power switch, a 9 pin RS-232 Payload and General Support Computer (PGSC) interface port, an Orbiter 28 V dc power connector, and an initialization pulse button. The power switch allows for fuse replacement if required. Alkaline batteries provide power to the data storage memory when 28 V dc power is unavailable.

The analysis module includes the hermetically sealed fluid path assembly containing the cells under study, all media for sustained growth, automated drug delivery provisions for testing of candidate pharmaceuticals, inline vital activity and physical environment monitors, integral fraction collection capabilities, and cell fixation facilities.

Experiment activities can be performed without any crew intervention other than initiation of the experiment at the beginning of on-orbit payload operations and termination of the experiment prior to deorbit preparation. Off-nominal activities include a fuse changeout requirement, as well as data file uploads and downloads and experiment troubleshooting using an SSP-provided PGSC (shared). Shared use of the PGSC will be on a non-impact basis. The payload configuration is shown in figure 3-1.

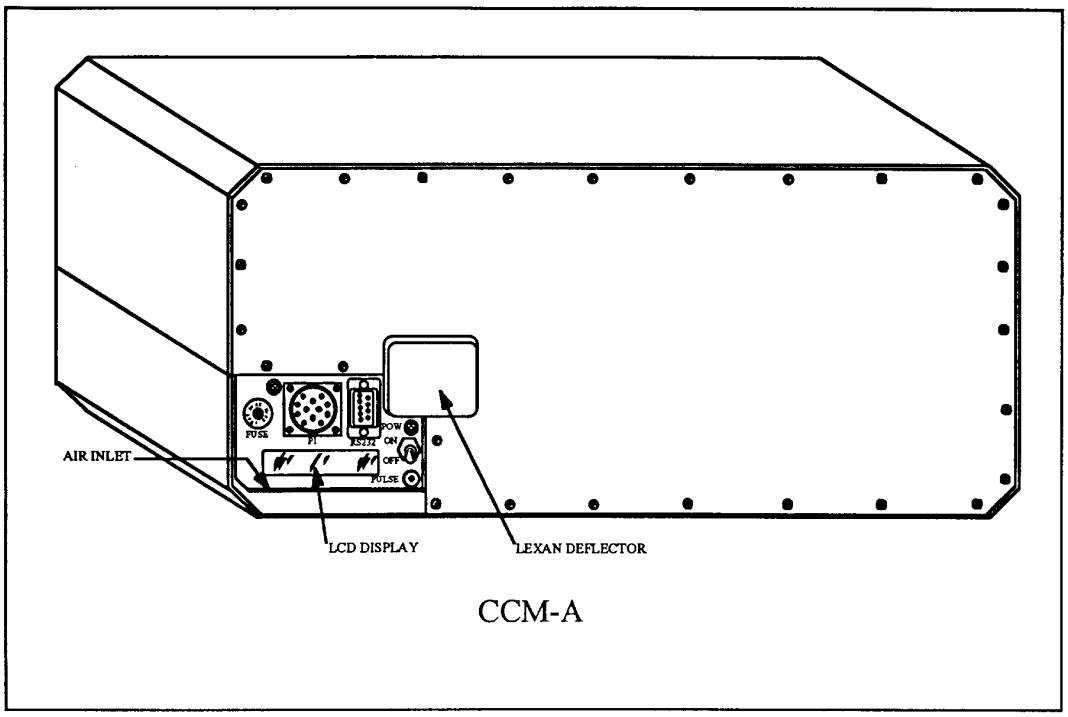


Figure 3-1.- CCM-A configuration.

3.2 Mission Overview

3.2.1 Integrated Ground Operations.- After the CCM-A experiment assembly is initially prepared for flight at the Life Science Support Facility (LSSF), control of the payload will be transferred to the SSP for late installation into the Orbiter. The SSP will perform integration of the payload with the Orbiter and will perform payload-to-Orbiter interface verification. See section 9.0 for requirements concerning late stowage, near continuous power, interface verification test, and refurbishment in case of launch scrubs.

3.2.2 Flight Operations.- As soon as possible following orbit insertion, the flightcrew shall provide the payload with a reference time tag by means of a pushbutton input on the front panel of the payload and log the time. The flightcrew shall be available at regular intervals to monitor payload operation as negotiated between the customer and the SSP through the Flight Planning Annex (Annex 2). The payload shall be configured for landing by the flightcrew prior to start of deorbit burn preparations.

3.2.3 Postlanding.- The G-sensitive nature of the experiment requires that the payload be removed from the Orbiter as soon as possible after landing for immediate analysis of the samples. Refer to section 9.4 for details regarding early removal postlanding requirements.

4.0 MISSION OPERATIONS

The mission operations section includes a definition of requirements and constraints by mission phase.

4.1 Payload Control Parameters

The payload control weight and payload control dimensions define the maximum weight and dimensions of the payload for SSP mission planning purposes. A payload may not exceed its control weight or control dimensions without SSP approval.

Payload control weight: CCM-A

Payload	57.2 lb (26.0 kg)
dc power cable	1.5 lb (0.68 kg)
PGSC RS-232C data interface cable (9 pin)*	1.5 lb (0.68 kg)
Data diskettes (2)*	1.4 lb (0.04 kg)
Total	61.6 lb (27.40 kg)

*RS-232 cable to be stowed separately and diskettes are stowed in Flight Data File (FDF).

The payload control weight does not include packing material nor the locker.

The payload control dimensions do not exceed the internal dimensions of one standard middeck locker allowing for 1/2 in. of isolating foam around the payload.

The customer shall provide weight and configuration drawings to the Orbiter Crew Compartment Interface Control Annex (Annex 6).

4.2 Operational Requirements and Constraints

The following payload operational requirements and constraints will be used in the flight planning and implementation of the Space Shuttle/payload mission. Requirements that impose flight design and/or crew activity constraints will be implemented to the extent practical within primary payload objectives or mission objectives as determined by the SSP.

4.2.1 Launch Readiness.-

4.2.1.1 Prelaunch Constraints:

a. The customer has the responsibility to immediately notify the SSP of problems which could affect launch schedules, mission success, or safety.

b. The payload requires late installation (within L-24 hr) into the Orbiter middeck. The exact time for installation will be mission specific and defined in the PIP Annex 9. Late installation is to be completed by L-14 hr.

c. The payload will be in final lift-off configuration when installed in the Orbiter. At this time, the payload will be capable of sustaining this configuration without physical access or SSP support in the event of weather/equipment holds.

d. The payload also requires removal and refurbishment or replacement with the backup payload flight locker in the case of launch scrubs. The time when the payload requires removal and replacement will be mission specific and will be defined in the PIP Annex 9.

4.2.1.2 LCC: The payload will not constrain launch.

4.2.2 On-orbit.- Payload operations shall be performed by the flightcrew per a customer-provided procedure no sooner than 2 hr after launch. Payload-provided displays and controls will be used by the flightcrew to monitor and operate the payload. The flightcrew shall be available to monitor and perform operations for the payload to the extent practical within primary payload objectives or mission objectives as determined by the SSP.

4.2.2.1 On-orbit Attitude: The payload has no on-orbit attitude or maneuvering requirements.

4.2.2.2 Thermal Environment: The payload design will be compatible with Orbiter thermal constraints as defined in NSTS 21000-IDD-MDK. It is highly desirable that the payload be located at least one locker away from any other heat producing middeck lockers. The maximum on-orbit cabin air temperature to which the payload may be exposed is 90 deg F.

4.2.3 Safe Without Services.- The SSP-provided services such as power, cooling, ventilation, etc., may not be available under certain conditions; i.e., postlanding, ferry flights, or certain KSC operations. In this event, the customer is responsible to ensure that the payload does not present a hazard to the Space Shuttle or to personnel, while maintaining design requirements. For loss of normal services during the mission, the payload design must comply with the safety requirements as defined in NSTS 1700.7B, with contingency safing power as defined in section 5.4.

5.0 PAYLOAD-TO-SPACE SHUTTLE INTERFACES

The Space Shuttle middeck interfaces are defined in the Shuttle/Payload Interface Definition Document for Middeck Accommodations, NSTS 21000-IDD-MDK, with which the payload must be compatible. Any interfaces will be specified in the Orbiter Crew Compartment Interface Control Annex (Annex 6).

Mission phase definitions applicable for this PIP are as follows:

a. Prelaunch - Period of time from payload installation in the Orbiter to Solid Rocket Booster (SRB) ignition.

b. Ascent - The period of time from SRB ignition through the establishment of a stable orbit (typically post-Orbital Maneuvering System (OMS) second burn).

c. Payload Preoperation - The period of time from just after the establishment of a stable orbit until the start of the operation sequence.

d. Payload Operation - The period of time from the start of the operation sequence until the completion of the postoperation reconfiguration.

e. Payload Postoperation - The period of time from the completion of the postoperation reconfiguration to start of preparation for entry.

f. Descent - The period of time from start of deorbit prep for entry through wheels stop.

g. Postflight - The period of time from wheels stop to the removal of the payload from the Orbiter.

5.1 Structural/Mechanical/Materials Interfaces

The standard structural/mechanical/materials interface between the payload and the Space Shuttle are defined in the NSTS 21000-IDD-MDK. Payload-unique interface requirements shall be documented in the annex 6.

5.2 Cable Interfaces

The payload will use a standard SSP-provided dc power cable to interface with a convenient utility outlet as described in NSTS 21000-IDD-MDK. For troubleshooting and anomaly resolution activities, the payload will use the standard SSP-provided (dc) power cables to provide power to the PGSC via an Orbiter utility outlet. The payload will use the standard SSP-provided 9 pin RS-232C data cables to interface with the PGSC as described in Shuttle/Payload Interface Definition Document for the PGSC, NSTS 21000-IDD-PSC. Specific wiring pin function assignments will be defined in the annex 6.

5.3 Display and Control Interfaces

For nominal flight operations, the payload shall provide its own unique Display and Control (D&C) for interface with the flightcrew. This D&C shall be documented by the customer in annex 6. For off-nominal operations, the SSP will provide the use of a PGSC to support in-flight payload operations. Shared

use of PGSC will be on a nonimpact basis. The customer is responsible for providing similar commercial computers and cables for ground development and customer-provided training. The SSP will provide a flightlike unit for a period of 2 weeks to be used for hardware/software verification test purposes. All payload software will be developed and provided by the customer. Programs and data will be stored on 3.5 in. diskettes.

5.4 Electrical Power Interfaces

Before installation in the Orbiter, the payload requires near-continuous power using an SSP-provided GSE battery system (optional service) as described in annex 8. During the Space Shuttle/payload ground and flight-mated operations, power will be supplied by the Space Shuttle as defined in the following paragraphs.

The payload electrical power requirements shall not exceed the allocations defined in NSTS 21000-IDD-MDK. The maximum continuous and peak power requirements are listed in table 5-1, and the Space Shuttle/payload interface voltage for the peak power value is defined in NSTS 21000-IDD-MDK, section 7.

Table 5-1.- ELECTRICAL POWER REQUIREMENTS

Source	Pre-launch	Ascent	Pre-operation	On-orbit Operation	Post-operation	Descent	Post-flight
CCM-A bus (dc)	28 W (70) W	28 W (70) W	28 W (70) W	28 W (70) W	28 W (70) W	28 W (70) W	28 W (70) W

(Value inserted where interface is required, N/A inserted where interface is not available, and N/R inserted where interface is not required; peak power values are identified by parenthesis)

The values listed in table 5-1 will be verified by test of the flight configuration with the results submitted to the SSP by the Flight Planning and Stowage Review (FPSR).

The specific power profile will be defined by the customer in annex 2 part I. Loss of Orbiter-supplied power on-orbit to the payload shall, as a minimum, require manual reconfiguration of

Orbiter power to restore power to the payload. The power will nominally be restored within 15 min of payload power loss detection.

The total energy shall not exceed 2.1 kWh/day.

5.5 Command Interfaces

For in-flight contingency operations only, the PGSC will be used for payload commanding and data file uploads and downloads between the payload and the PGSC. A customer-provided data diskette will be used for data file uploading and downloading.

5.6 Telemetry and Data Interfaces

For in-flight contingency operations only, the PGSC is used for data display and for payload data file uplinks and downlinks between the PGSC and ground via the Orbiter Communications Adapter (OCA). Additionally, customer-provided data diskette will be used to store data for postflight analysis.

5.7 Thermal Interfaces

The payload is cooled passively to the middeck.

The maximum continuous operating time is 24 hr per day. The touch temperatures of crew accessible panels and controls shall not exceed 113 deg F.

Refer to specific power profile in annex 2 part I for energy dissipation rates.

6.0 ENVIRONMENTAL ANALYSES AND INTERFACES

Standard Orbiter/payload natural and induced environmental interfaces, including structural loads, thermal, contamination, shock, vibration, acceleration and acoustics, are contained in NSTS 21000-IDD-MDK.

Environmental interface analyses will be conducted to determine physical and functional interface compatibility of the payload and the Space Shuttle. The specific analyses are described in the following paragraphs.

6.1 Structural Loads and Deflections

The customer is responsible for verifying compatibility with the Orbiter loads as defined in NSTS 21000-IDD-MDK. The customer will assure compliance of the payload by providing a test report including structural test data and analysis.

6.2 Thermal Environments and Interfaces

The customer shall provide a thermal report which includes test data and analyses to assure the payload compatibility with the SSP-defined thermal environment found in NSTS 21000-IDD-MDK. The payload thermal report will be used by the SSP to determine that the resulting thermal environments are compatible with the Orbiter. A thermal integrated assessment, if required to assure compatibility, will be performed by the SSP utilizing a payload-provided thermal model.

6.3 Electromagnetic Interference/Electromagnetic Compatibility

The customer is responsible for assuring that the payload meets the induced electromagnetic interference environment and that the entire payload complies with the radiated and conducted emissions and bonding requirements defined in NSTS 21000-IDD-MDK. The customer shall submit test data and analysis to the Payload Integration Manager (PIM) compliance with the above document.

6.4 Contamination Control

The customer is responsible for assuring that the payload is compatible with the induced contamination environment and complies with the offgassing requirements as defined in NSTS 21000-IDD-MDK. In addition, certain materials and equipment requirements apply during ground operations in (or close proximity of) the Orbiter. The customer will comply with these requirements as defined in NSTS 08242, Limitations for Nonflight Materials and Equipment Used in and Around the Space Shuttle Orbiter Vehicle.

Prior to installation into the locker, the external surface of the payload will be visually inspected and cleaned as necessary.

Specific facility operational requirements are contained in KSC Payload Facility Contamination Control Requirements/Plan, K-STSM-

14.2.1; Shuttle Facility Contamination Control Implementation Plan, KVT-PL-0025; and Cargo Facility Contamination Control Implementation Plan, KCI-HB-5340.1.

6.5 Shock, Vibration, Acceleration, and Acoustics Environments

The customer is responsible for assuring that the payload is compatible with the shock, vibration, acceleration, and acoustic environments defined in NSTS 21000-IDD-MDK. A report shall be provided by the customer to reflect compliance with the middeck environmental requirements of NSTS 21000-IDD-MDK.

6.6 Ground Environmental Requirements

The environment of the ground operations facilities at the launch site is specified in KSC Launch Site Accommodations Handbook, K-STSM-14.1. Ground Handling loads are always less than flight loads.

6.7 Materials and Processes

Materials and processes will be in accordance with NSTS 1700.7B.

7.0 INTEGRATION HARDWARE

The responsibilities for the integration hardware are defined in the following paragraphs.

7.1 SSP-provided Hardware

The following unique hardware will be provided by the SSP.

a. One standard middeck utility dc power cable

b. One PGSC (shared, for contingency operations only)

c. One standard 9 pin RS-232C data interface cable

d. One standard dc PGSC power cable (shared, for contingency operations only)

e. GSE battery systems (28 ± 4 V dc)

f. Two standard middeck lockers with modified doors (one primary locker, one backup locker)

7.2 Payload-provided Hardware

a. Two payload assemblies (one primary and one backup)

b. One spare fuse (contained in a ziplock bag)

c. Two data diskettes (a primary and a backup diskette) with backup CCM files

8.0 FLIGHT OPERATIONS

This section defines the flight design, flight activity planning, flightcrew and flight controller training, and flight operations support activities required for SSP/payload integration.

8.1 Flight Design

The SSP will be responsible for performing integrated flight design. The constraints for flight design are defined in section 4.0. The customer will provide flight design information in annex 2.

8.2 Flight Activity Planning

8.2.1 Flight Plan.- The JSC will be responsible for all flight planning and will develop an integrated Space Shuttle/payload Flight Plan to support the flight. The plan will be developed using the customer-supplied payload crew activity requirements. The customer will provide these requirements as part of annex 2.

8.2.2 Payload Operating Procedures.- The customer is responsible for the development and verification of payload systems operating procedures. The payload systems operating procedures are provided by the customer and transmitted to the JSC via the FOSA Annex 3. These procedures will be used by the JSC to generate the integrated SSP/payload procedures.

8.3 Training

The SSP is responsible for assessing the training requirements for the flightcrew and NASA flight controllers to support the flight. The conduct of the payload-unique portion of this training will require SSP and customer resources as defined below.

The customer shall provide a payload familiarization briefing at JSC of up to 8 hr for up to 40 of the flight crewmembers, SSP flight controllers, and NASA instructors. To prevent scheduling conflicts between customer-provided payload training and integrated mission simulation training (which normally begins at L-13 weeks), the customer will adhere to the following scheduling guidelines: The customer should be prepared to define his payload training requirements (e.g., lesson sequence, lesson content, and NASA facility requirements) to the SSP no later than L-8 months. All payload procedures and training hardware/software shall be ready to begin flight crewmember training no later than L-6 months. All customer-provided training, or customer-required training, must be completed no later than L-13 weeks. The customer is encouraged and may be required to support Joint Integration Simulations (JIS's) at JSC when his payload timelines are exercised.

For customer-required training, the SSP will provide, as a standard service, the travel costs associated with sending the flightcrew and support personnel to the customer training facility for up to two trips of 2 days per trip. Travel costs associated with customer-required training which exceed this allocation will be an optional service cost to the customer.

The SSP will provide generic Mission Control Center-Houston (MCC-H) facility training for (no. not to exceed 15) customer representatives resident in the MCC-H during a mission. This training will be conducted by the use of workbooks and up to 5 hr of hands-on training for each representative. Key payload representatives are encouraged to participate in an applicable payload portion of an integrated simulation(s) to become familiar with MCC-H operations.

8.4 Flight Operations Control

The SSP will be responsible for integration of flight operations. The SSP flight control operations will be conducted from the NASA MCC-H using the Spaceflight Tracking and Data Network (STDN).

When considered to be necessary by the SSP, the customer will provide a representative(s) at the MCC-H during the SSP/payload flight to provide a contact(s) for payload decisions to the SSP, to assess flight progress, and to coordinate operations interfaces between the SSP and the customer. The basic plan, payload decision points, and agreements for these operations, including necessary procedures, will be identified in annex 3.

8.5 In-flight Maintenance

All payload In-flight Maintenance (IFM) shall be designed so that safety requirements will not be compromised. Only IFM procedures reviewed and approved by the safety panel will be authorized. Any payload IFM requires real-time concurrence from the Space Shuttle commander. All IFM will be documented in annex 3.

8.6 Ground Command and Control

During the mission, the payload will be monitored from the Experiment Monitoring Area located in the LSSF at KSC (optional service) and from the Customer Support Room (CSR) at JSC.

In support of the payload monitoring functions, the SSP will provide the payload with three voice circuits (monitor only). These voice circuits are Flight Director (FD), Air-to-Ground (A/G) 1, and A/G 2.

9.0 LAUNCH AND LANDING SITE OVERVIEW

Payload-unique activities and an overview of L&L site activities are presented in this section. Overall SSP policy and requirements are shown in Space Shuttle System Payload Accommodations, NSTS 07700, Volume XIV, Appendix 5. Ground processing details and customer-requested ground support (both nominal and contingency) are documented in annex 8, by the Launch Site Support Manager (LSSM), according to the schedule shown in section 15.0.

In support of annex 8 development, the customer participates in Ground Operations Working Group (GOWG) meetings that further define the payload L&L requirements and plan for their implementation. All customer Technical Operating Procedures (TOP's) will be submitted to the LSSM 45 days prior to use for KSC review/approval. The customer also makes inputs to and

supports the schedule for SSP development of L&L operational procedures.

The SSP will take required photographs of the payload before and after installation in the Orbiter to support FDF development, flightcrew and flight controller training, and for possible in-flight contingencies. These photographic activities will be scheduled and coordinated with the customer.

Training or certification of training may be required for customer personnel performing certain payload ground processing activities. Health reports or physical examinations will be required for certain operations, such as deployment to non-Continental United States (CONUS) landing sites. Details are included in the annex 8.

The customer's management will establish worktime policies and rules that meet realistic human factors, personnel safety, and quality assurance goals. The purpose of these policies is to minimize the probability of mishaps caused by personnel in critical positions working excessive hours during operations at KSC. Certification of compliance is required in some instances. Details are in the LSSP.

9.1 Customer Processing

Upon arrival at the launch site, the payload hardware is delivered to the LSSF for postshipment customer inspection, functional checkout, and preparation for transfer to SSP control. Typically, responsibility for these preintegration activities rests with the customer and uses payload-provided GSE.

After these activities are completed, the payload is transferred to L&L control and connected to a SSP-provided GSE battery system to begin the ground integration process.

During the mission, the customer requires the capability in the LSSF at KSC to monitor A/G 1, A/G 2, and the Mission Control Center (MCC) FD voice loop.

9.2 Payload Integration

Not applicable

9.3 Orbiter Integration

Middeck payloads will be installed and any Interface Verification Tests (IVT's), closeout procedures, and payload-unique tests will be accomplished by the SSP. During ground processing, the payload can sustain power losses for up to 15 min.

The payload requires late installation (within L-24 hr) into the Orbiter middeck. The exact time for installation will be mission specific and defined in the PIP Annex 9. Late installation is to be completed by L-14 hr.

The payload also requires removal and refurbishment or replacement with the backup payload flight locker in the case of launch scrubs. The time when the payload requires removal and replacement will be mission specific and will be defined in the PIP Annex 9 (OMRSD).

Agreed-upon prelaunch services to be performed for the payload are as follows:

a. Late installation into the Orbiter middeck

b. Near-continuous power (15 min maximum interrupt)

c. GSE battery system (28 ± 4 V dc)

d. Launch site laboratory facilities and support service

e. Air-conditioned payload transportation from LSSF to pad

Requirements for late installation within L-24 hr of payloads which also require interface verification testing may affect manifesting. Late installation requirements will require coordination with the Launch Team/Launch Director during the launch countdown planning process.

9.4 Postlanding

The tissue cells begin their readaptation process to the 1-G environment during reentry. As a result, it is crucial that the payload be removed from the Orbiter as soon as possible after landing for immediate postflight analysis. Removal of the payload from the Orbiter after 1.5 hr following wheel stop will result in significant loss of science.

9.4.1 Nominal Landing Processing.- After landing at the primary or first alternate End of Mission (EOM) landing site, the payload will be removed from the Orbiter prior to Orbiter tow but no later than landing plus 3 hr. As soon as possible following removal from the Orbiter, the payload will be placed in a KSC-provided vehicle and connected to GSE power. During landing processing, the payload can sustain power losses for up to 15 min. The payload will be transported directly to a landing site laboratory, as detailed in annex 8. In the event of an Early End of Mission (EEOM), the payload requires early destow support beginning at a Mission Elapsed Time (MET) of launch plus 2 days at KSC. At the first alternate landing site, EEOM support will be provided only on a best effort basis by the SSP.

Agreed-upon services to be performed at the primary and first alternate landing sites for this payload are as follows:

a. Early payload removal from the Orbiter

b. KSC-provided vehicle to immediately transport the payload from the Orbiter to the landing site laboratory facility for immediate specimen analysis (needed only if the standard payload transportation vehicle was being shared with other middeck payloads)

c. Landing site laboratory facility and support service

d. GSE battery systems (28 ± 4 V dc)

e. EEOM support beginning at launch plus 2 days for KSC landing. SSP best efforts for EEOM support at first alternate landing site.

f. Near-continuous power (15 min maximum interrupt)

9.4.2 Intact Abort Processing.- If an aborted flight lands at the primary or first alternate EOM landing site, the payloads will be removed and dispositioned in a manner similar to that described in the previous sections. Support prior to L+48 hr and for all other landing sites and contingencies will be on a best-effort basis by the SSP.

If an aborted flight lands at a CONUS site other than the primary or first alternate EOM landing site, the payload will be removed from the Orbiter middeck by the SSP and turned over to the customer at the landing site. For all non-CONUS abort landing

sites, the payload will be removed and returned by the SSP to the launch site.

The customer or customer representatives are responsible for the performance of all payload-unique operations (data removal, preparations for transporting, etc.) and provide the personnel and GSE to conduct these operations. Within the transportation provisions for the SSP GSE and personnel, the SSP will provide, on a space-available basis, transportation of payload-unique GSE and personnel to and from the landing site.

10.0 SAFETY

10.1 General

The customer is responsible for ensuring that the payload and the GSE, including interfaces and operations, are safe. Payload and GSE design and operations must comply with the safety requirements defined herein. Payload compliance with the safety requirements is assessed by the SSP through flight and ground safety reviews (up to four) and safety certification. Successful completion of these safety reviews and of the safety certifications by the customer will result in approval by the SSP for ground processing and flight.

In order to preclude hazardous operations, full disclosure of all operating parameters, including but not limited to pressures, temperatures, and voltages and power, will be required. In addition, full disclosure of the contents, flammability, and Hydrogen-Ion concentration (pH) and toxicity of all substances including proprietary material used in or produced by any payload or experiment will be made. These disclosures will be made to the safety panel no later than L-6 months. The flightcrew, the assigned mission FD's and lead mission flight surgeon will be notified by the safety panel. The payload must comply with the toxic labeling standards defined in System Description and Design Data - Intravehicular Activities, NSTS 07700, Volume XIV, Appendix 9.

10.2 Payload Design and Flight Operations Requirements

The payload, including interfaces and operations will comply with the requirements of NSTS 1700.7B. The payload shall meet these requirements at the launch/landing sites and during flight and orbital operations.

All interaction/interface safety analyses will be performed by the customer for the payload interfaces with the Orbiter. In this analysis, failures identified in Shuttle Orbiter Failure Modes and Fault Tolerances for Interface Services, NSTS 16979, and the flight operations will be assessed by the customer. The analysis will define assumptions made by the customer with respect to Orbiter services and operations associated with hazardous payload functions. The analysis will identify potential payload failures which could propagate to the Orbiter and exceed the design criteria in Space Shuttle/CCM-A Interface Control Annex.

During real-time SSP operations, the SSP has final safety responsibilities. Payload organizations have the responsibility to support the SSP by providing expert advice on safety matters affecting the payload or its operation.

10.3 GSE Design and Ground Operations Requirements

Payload and GSE design including interfaces and operations will comply with the requirements of NSTS 1700.7B and 45 SPW HB S-100/KHB 1700.7, for launch site processing and postlanding operations including abort, contingency, and emergency landings. Other launch/landing site safety requirements may be applicable, depending upon assessment by SSP of the payload and GSE operations.

Hazardous and nonhazardous TOP's will be submitted to the LSSM for Launch Site Safety Office (LSSO) review. Hazardous TOP's must be approved by the LSSO to permit publication of the TOP's 30 days before use.

10.4 Safety Review Requirements

The implementation of the safety requirements of NSTS 1700.7B and 45 SPW HB S-100/KHB 1700.7 will be accomplished in accordance with Implementation Procedure for NSTS Payloads System Safety Requirements, NSTS 13830. Safety documentation will be provided by the customer to the appropriate SSP organization for each safety review: JSC for flight design/operations and KSC for ground design/operations. The safety review meeting will be scheduled approximately 45 days after the receipt of an acceptable data submittal. Flight design and operations safety reviews will be coordinated/scheduled by the JSC safety office

and the ground design and operations safety reviews will be coordinated by the KSC LSSM.

Flight and ground Phase III Safety Review(s), including closure of ground safety verification, and ground safety certification must be completed 30 days prior to payload (and GSE) delivery to KSC. The customer will be required to identify any open verification status items from the flight Phase III Safety Review, as reported in the Payload Flight Safety Verification Tracking Log, and provide rationale for acceptance of this condition prior to commencement of ground processing. Flight safety certification must be completed 10 days prior to the FRR.

When changes to the design or operations of the payload/(GSE) are required subsequent to Phase III, the customer shall assess those changes for possible safety implications, including the effect on all interfaces. The assessment shall be forwarded to the JSC and/or KSC safety panel for review and approval. The assessment shall include the reason for the change and the safety impact, if any. New or revised hazard reports and support data shall be prepared when applicable and also submitted for approval. The need for a delta Phase III Safety Review will be determined by hazard potential involved. Satisfactory completion of all this activity is mandatory prior to launch.

All verification activities including post-Phase III Safety Review operations will be reported to the SSP Payload Safety Panel by procedure numbers, location where performed, and date as described in NSTS 13830.

For changes to GSE design and ground operations, the restriction is that the changes must be approved by the LSSO and the KSC safety panel prior to the use of the GSE or procedure.

In conjunction with the FOR, the payload configuration including systems and procedures, will be reviewed by the SSP with customer participation to highlight safety concerns and resulting operations decisions. In support of this review, the customer will provide the payload officer and the JSC Payload Safety Review Panel with any additional safety-related data which may impact flight operations decisions.

10.5 Biomedical Payloads/Experiments

All payload investigations involving flight personnel as test subjects or as operators of payloads/experiments that have potential biological/medical risks must be approved by the JSC Human Research Policy and Procedures Committee (HRPPC). Approval

by the HRPPC will be in accordance with Human Research Policy and Procedures for Space Flight Investigations, JSC 20483.

11.0 INTERFACE VERIFICATION AND TESTING

The customer is responsible for verifying compatibility with the interfaces and environments specified in the PIP and applicable ICD's. The interface verification requirements and planning will be negotiated and concurred in by the SSP and the customer.

All payload-to-Orbiter interface verification requirements are to be identified and submitted by the customer in the Payload Verification Requirements Annex (Annex 9), in accordance with the schedule in section 15.0 and the requirements specified in NSTS 14046, Payload Verification Requirements. Those interfaces that cannot be verified prior to flight shall also be documented in annex 9 with supporting rationale. The format of the Interface Verification Requirements is specified in the NSTS 21000-A09.

12.0 POSTFLIGHT DATA REQUIREMENTS

The NASA is responsible for Space Shuttle system monitoring and anomaly resolution. In the event of a Space Shuttle anomaly which would influence the execution of payload mission, the SSP will supply the Space Shuttle data, as available, to the customer for evaluation.

In the event of a payload anomaly, Space Shuttle data may be required for evaluation of the payload problem.

Postflight data listed below will be provided as an optional service.

a. Photographic - One photo of the CCM-A experiment upon completing entry preparation

b. FDF - One reproducible copy of the annotated payload FDF

c. PGSC diskette(s) - All PGSC data diskettes provided by the customer and used during contingency operations

13.0 SUMMARY OF NONSTANDARD SERVICES

There are no nonstandard services identified for this payload.

14.0 PIP ANNEXES

As identified in other sections of the document, the following annexes are required from the customer in the SSP standard format.

In case of any conflict between this plan and the following PIP annexes, the PIP shall take precedence. Any requirements submitted in the annexes that are not within the scope of the PIP will not be considered binding on the SSP for implementation.

Annex 2 - Flight Planning (Parts I and II)

Annex 3 - Flight Operations Support

Annex 6 - Orbiter Crew Compartment Interface Control

Annex 8 - Launch Site Support Plan

Annex 9 - Payload Verification Requirements

15.0 SCHEDULE

Figure 15-1 provides a generic middeck payload integration schedule (L-dates), which details the various technical areas requiring data exchange and/or products in support of the SSP/payload integration activities. Upon manifesting to a flight, a mission-specific schedule for CCM-A will be developed and maintained by the payload customer and approved by the CCM-A PIM for each mission.

16.0 APPLICABLE DOCUMENTS

The following current issue documents are applicable to the extent stated herein. Current issue includes all future changes and revisions.

a. Safety Policy and Requirements for Payloads Using the Space Transportation System, NSTS 1700.7B

b. Implementation Procedure for NSTS Payloads System Safety Requirements, NSTS 13830

c. Shuttle/Payload Interface Definition Document for Middeck Accommodations, NSTS 21000-IDD-MDK

d. KSC Launch Site Accommodation Handbook, K-STSM-14.1

e. Mission Integration Control Board Configuration Management Procedures, NSTS 18468

f. Space Shuttle System Payload Accommodations, NSTS 07700, Volume XIV, Appendices 1-10

g. Payloads Configuration Management Handbook, KHB 8040.4

h. Payload Verification Requirements, NSTS 14046

i. Human Research Policy and Procedures for Space Flight Investigations, JSC 20483

j. KSC Payload Facility Contamination Control Requirements/Plan, K-STSM-14.2.1

k. Shuttle Facility Contamination Control Implementation Plan, KVT-PL-0025

l. Cargo Facility Contamination Control Implementation Plan, KCI-HB-5340.1

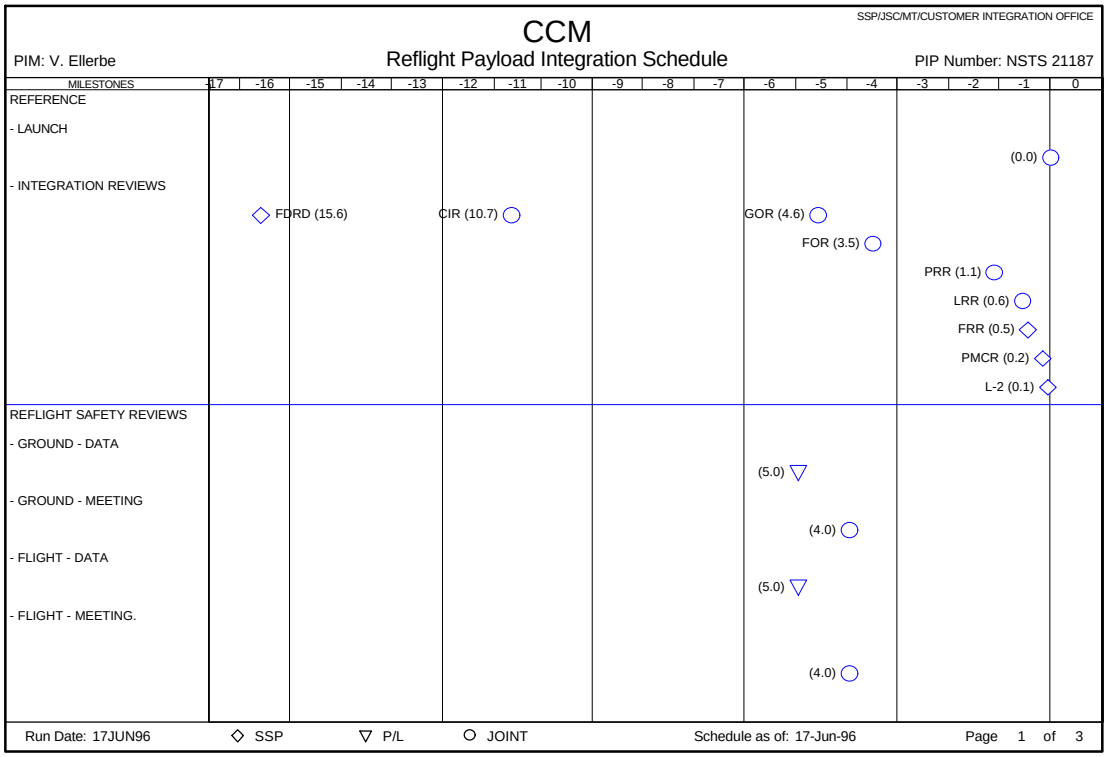
m. 45 SPW HB S-100/KHB 1700.7, Space Transportation System Payload Ground Safety Handbook, current issue

n. Shuttle Orbiter Failure Modes and Fault Tolerances for Interface Services, NSTS 16979

o. Limitations for Nonflight Materials and Equipment Used in and Around the Space Shuttle Orbiter Vehicle, NSTS 08242, current issue

p. Title 14 CFR 1214.7, Authority of the Space Transportation System (STS) Commander

q. NSTS 07700, Volume VIII, National Space Transportation System



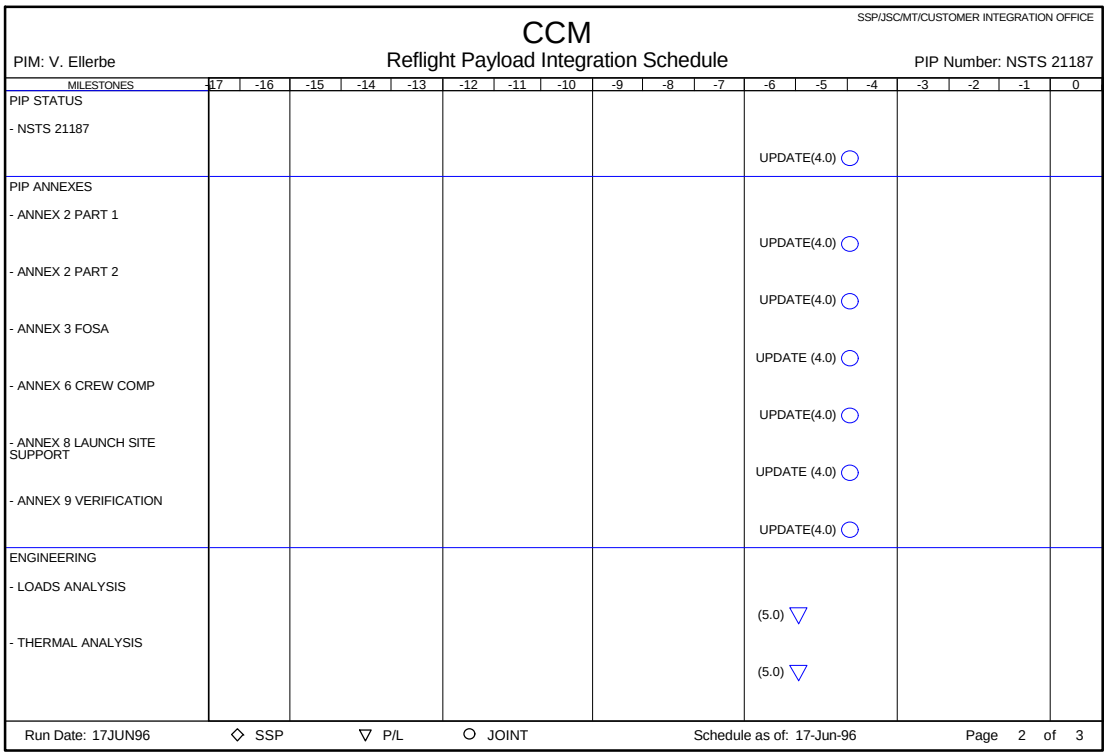


Figure 15-1.- Payload integration schedule (sheet 1 of 2).

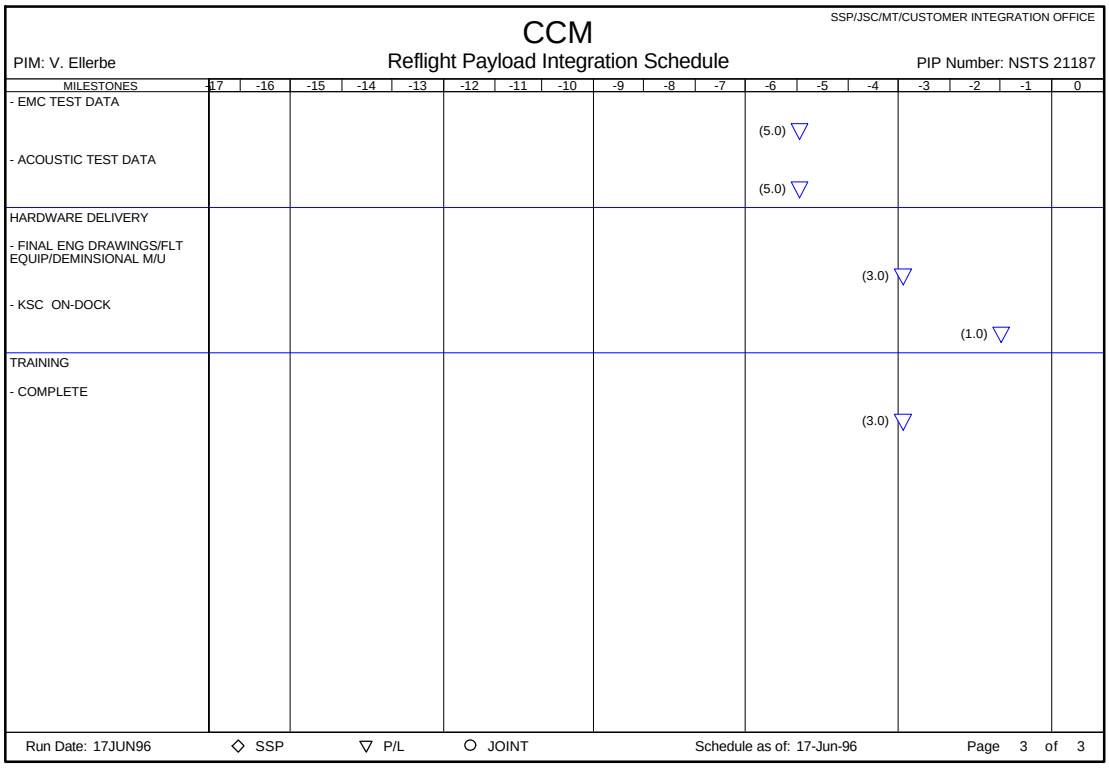


Figure 15-1.- Payload integration schedule (sheet 2 of 2).

PRINTING COMPLETED